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US 4813302 A **US 4019405 A**

(58) Field of search
UK CL (Edition L) **F2D DTC**
INT CL[5] **F16H 3/00**
Online databases: WPI, CLAIMS

(54) Radial change multigear, comprising gear which is radially movable relative to a recessed disc

(57) This gear system can consist of one or two hard metal discs into which shaped recesses have been cut at chordal intervals (each equal in length) to form circles at suitably chosen radii, into which a moveable cogwheel or pinion may be engaged by a radially sliding selector mechanism when the disc is stationary at certain points of recess alignment called Prime Radii, thus providing a selection of speed and torque ratios to the drive.

A combination of disc gears will provide a simple shaft drive system for turning a drilling machine, or the propelling of a pedal cycle, make provision for a greater range of gear changes, (relative speed and torque ratios,) and the turning motion will be transferred from the recessed disc turned by the pedals to a cogwheel fitted to a square or splined shaft which carries the motion to a similar cogwheel at the other end of the shaft which in turn is engaged with a recessed disc fitted to the rear wheel which drives the bicycle along.

On a bicycle then, the chainwheel, chain and the rear wheel sprocket will be replaced by a multispeed disc drive, to a cog driven shaft to a cog driving a multi speed disc at the rear wheel.

FIG.1

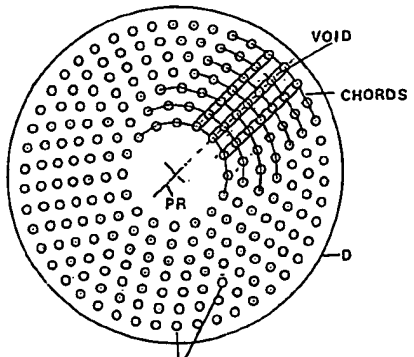
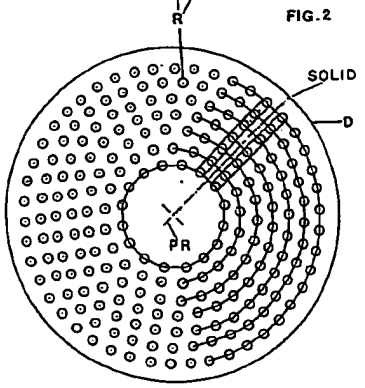


FIG.2



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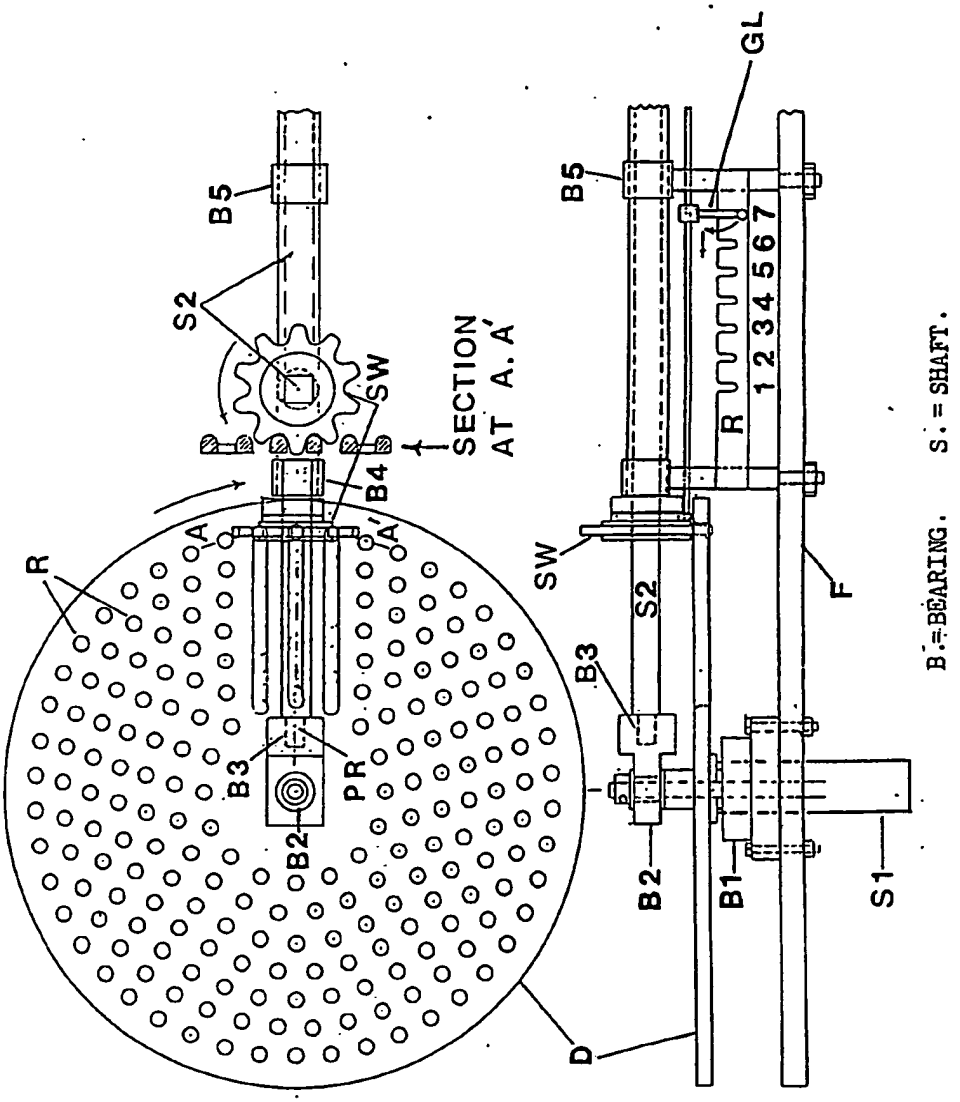
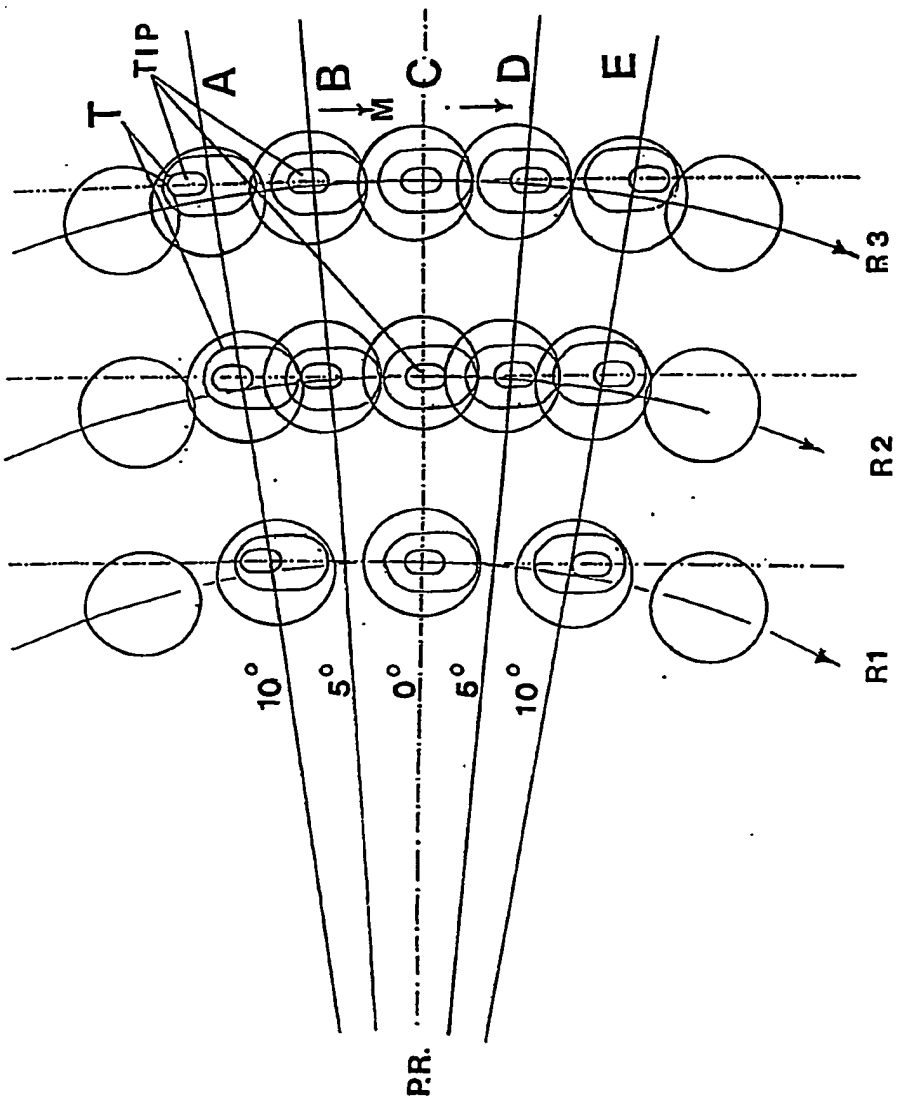

B5
S2
SW
B4
SECTION AT A.A'
A
A'
R
B3
PR
B2
GL
B5
R
1 2 3 4 5 6 7
SW
S2
F
B3
B2
B1
S1
D
B.=BEARING. S.=SHAFT.



D.C.

FIG.1

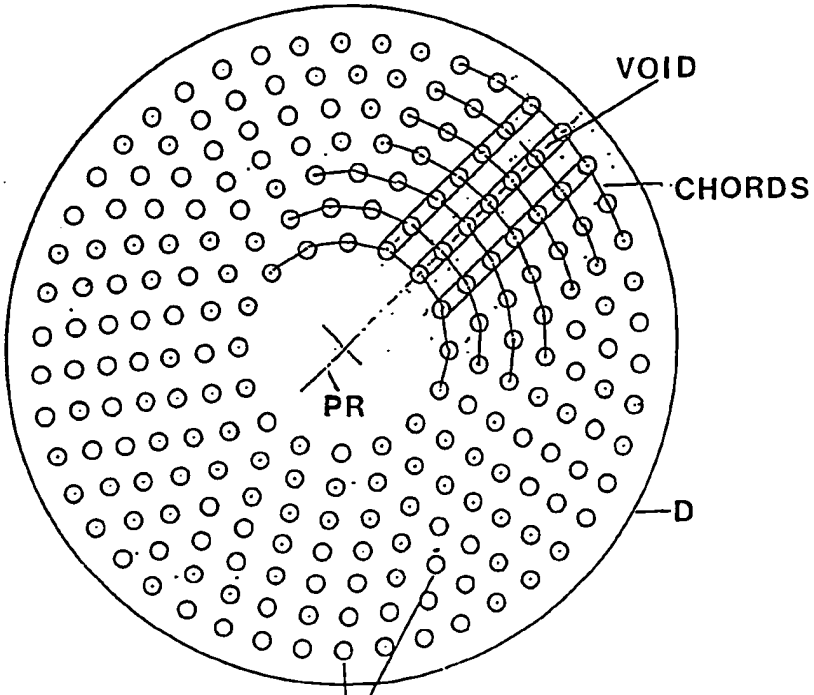
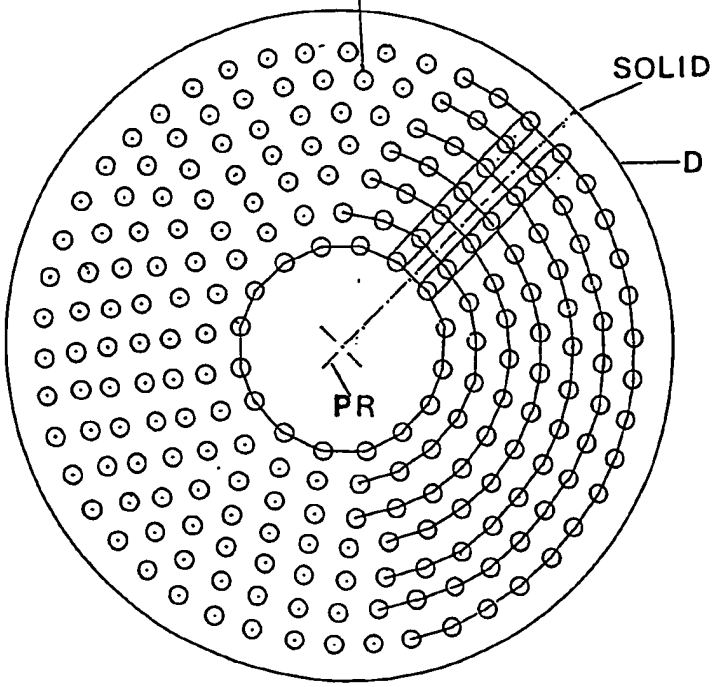
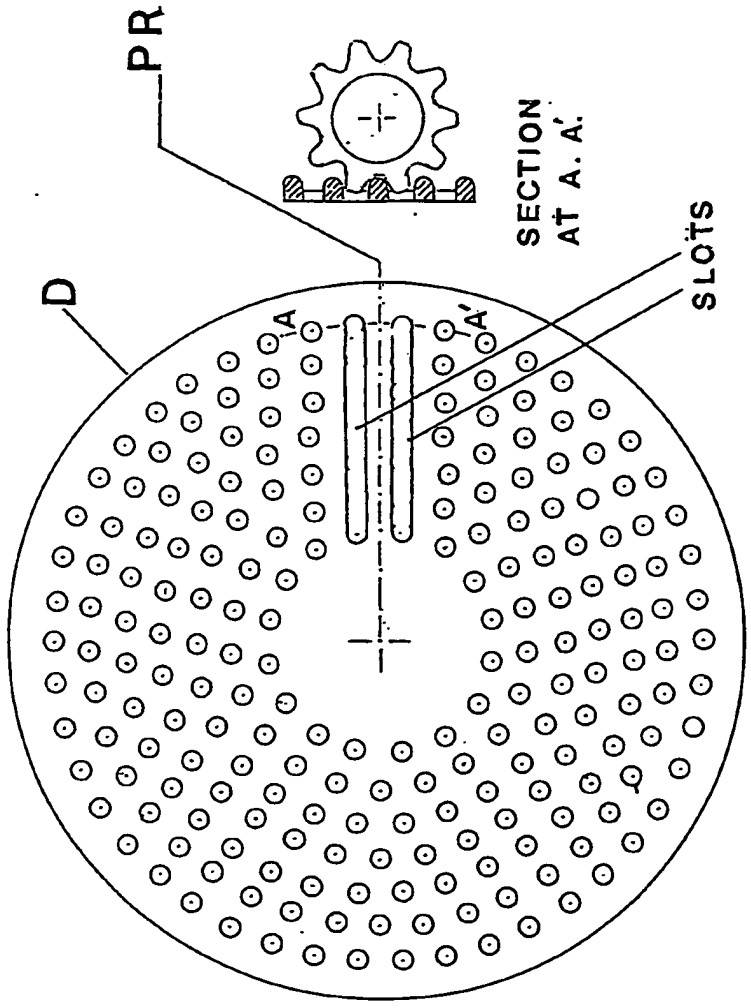


FIG.2




PR
SECTION AT A. A'
SLOTS
D
A
A'

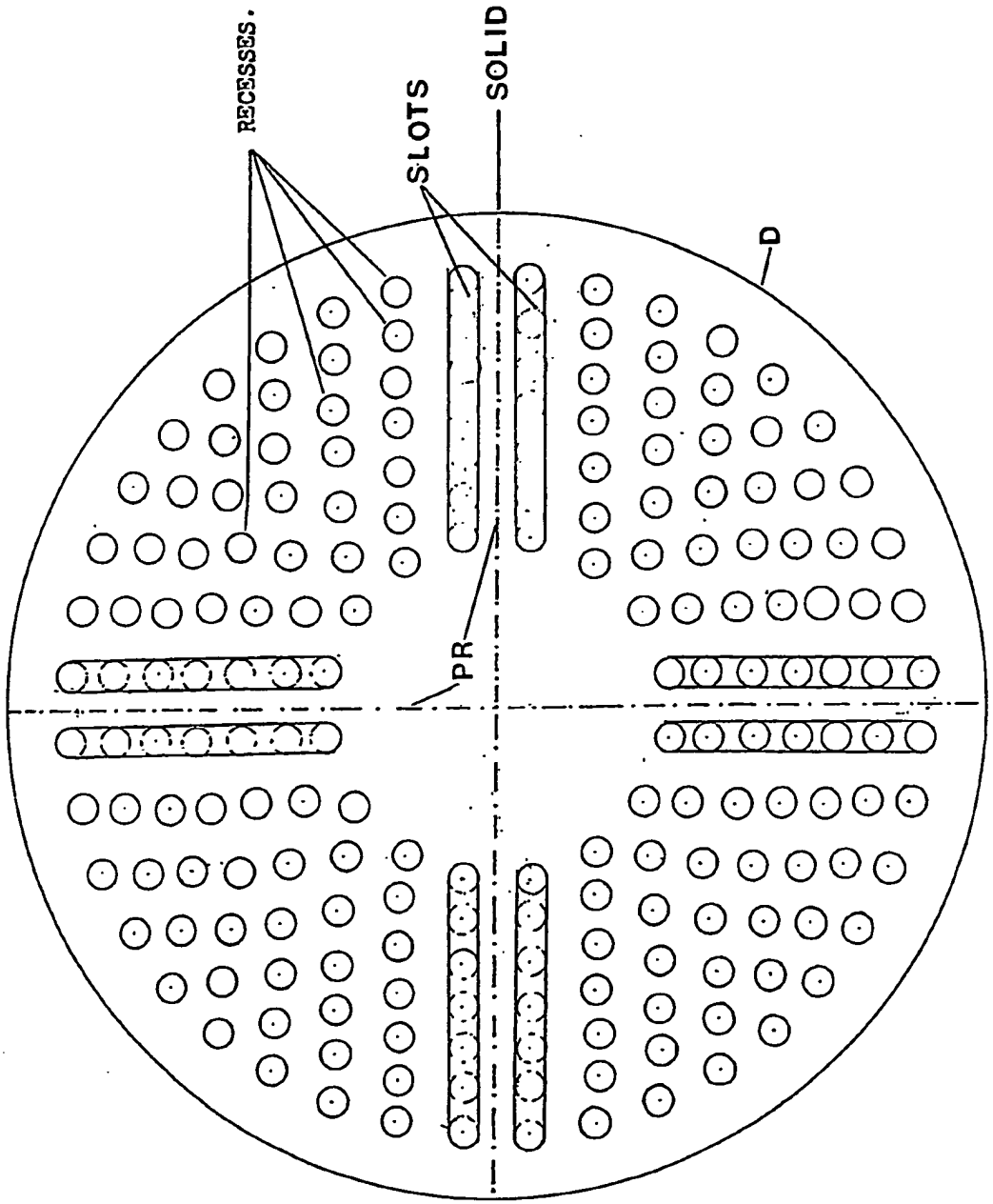

RECESSES.
SLOTS
SOLID
D
PR

FIG.1.

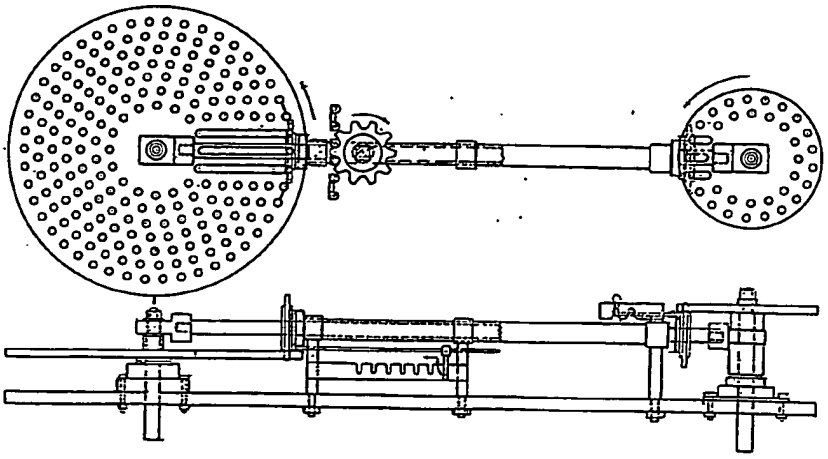
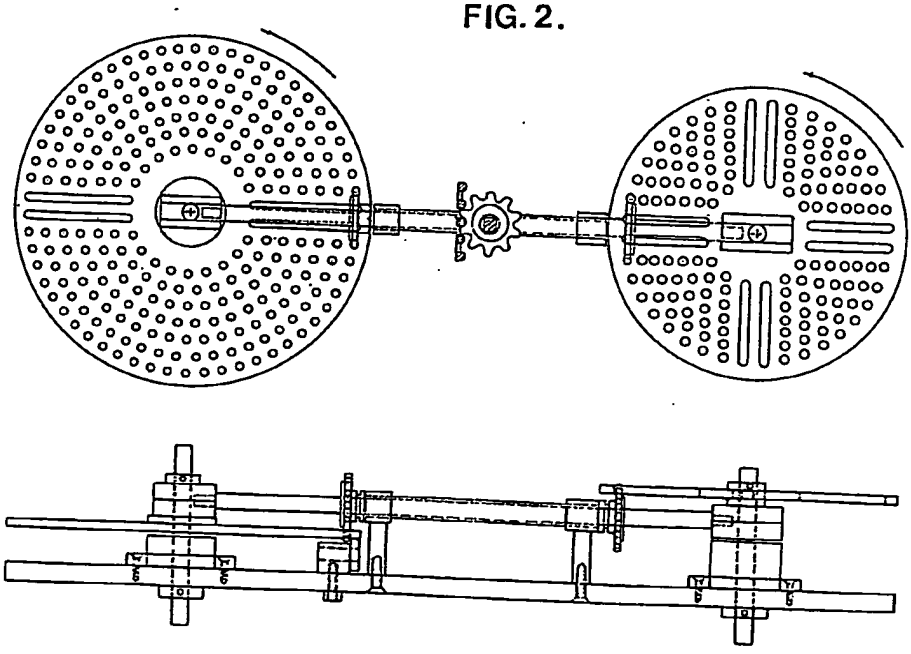


FIG. 2.



THE RADIAL CHANGE MULTIGEAR.

This invention relates to a variety of light applications, where a wide range of gears and a rapid change over from one to another is required:- Eg.1. A pedestal drilling machine is driven by a fixed speed electric motor, but this often needs to be changed. It is changed by stopping the machine, removing a belt from a cone pulley, moving it to a different setting, tensioning it, then restarting the motor. This system is time consuming and has a very limited range of speeds.

Eg. 2. The modern bicycle has a chain driven gearing system in which the chain is caused to jump from one sized sprocket after another in another in order to effect the required gear ratio. It involves a complex system of levers and spring activated pulleys to absorb the variations in the chain length requirements as the differents sized sprockets are selected.

The whole system is cumbersome, complicated, heavy, difficult to adjust and the gears cannot easily be changed until the cycle is being ridden.

On some of the gears, the drive is often effected with a misaligned position of the chain drive and when the rear wheel needs to be removed, it is an awkward and messy operation.

According to this invention: A gear changing system has been designed to completely eliminate the belt removal system on an electric drilling machine, increase the number of ratios available and cut the gear ratio changing time down from minutes to seconds.

In the case of the bicycle, this invention will eliminate the need for a chain drive completely, provide an easy and simple selection from a greater number of gears which can be effected whether the cycle is being ridden or or stationary and the rear wheel will be much easier to remove and replace when repairs are required to the tyres.

This gearing system will be lighter in weight, easier to use, far more simple in construction and having fewer moving parts; more efficient.

THE RADIAL CHANGE MULTIGEAR. (Refer to drawing on 1/6.) consists of a hard steel disc (D) mounted at its centre on a steel shaft (S1.) Into this disc, recesses have been specially positioned and shaped to correspond with the tooth penetration profile of a small pinion wheel (or STARWHEEL,) SW. which is fitted on a square, or suitably splined shaft (S2.) which is positioned over the PRIME RADIUS (PR.) at the correct height to mesh with the recsses cut into the disc.(D.)

The shaft (S2.) is supported by substantial bearings at the centre of the disc (D.) by bearings B2.& B3., B4. at the perimeter of the disc and B5. at the end of the shaft S2. This arrangement allows the pinion (Starwheel.) SW. to rotate in mesh with the recesses on the disc D.and allows it to slide along its axis radially from the central region of disc D. to its perimeter and back when the conditions are set up for it to do so.(because it is mounted on a splined or squared shaft.)

(Refer to 1/6. .)

Several concentric circles of recesses can be cut into the disc (D.) corresponding with the number of gear ratios required, the circumference of each circle being calculated to accommodate exactly a round number of chords; each chord being equal in length to the pitch length of the points on the Starwheel (SW.) engaging them.

Each of the concentric circles of recesses are set out, starting from a zero line which is the prime radius (PR.) so that all the circles are positionally related to each other in that they each have a recess centred on this common radius line (PR.).

A disc set out in this way may have 48 or more, recesses in its outer circle, descending to as low as 16 at its centre region. With a Starwheel (SW.) of ten teeth engaging them, this would produce gear ratios from 4.8 to 1., down in reducing steps to 1.6 to 1.

Since the recesses for each circle are set out on the prime radius (PR) they form a straight line along it from the centre region to the perimeter and, (allowing for very slight changes due to the decrease in radius of each successive circle,) the lines of recesses on either side of the prime radius (PR.) are very close to being parallel with it.

To permit the Starwheel (SW.) to traverse along the prime radius (PR.), the metal between the recesses along this radius has been removed, so that a long slot remains. In this case, the Prime Radius (PR.) could be said to be VOID CENTRED. An alternative to this is shown on, (Fig. 2. 3/6.)

(REFER TO PAGE 1/6)

The slot which remains in the place of the line of recesses is cut so that the whole of its length has the profile necessary for the clear traverse of the Starwheel (S.W.) along it and the correct engagement when in rotation still remains. On the Prototype the metal has been removed from the rows of recesses on either side of it for experimental reasons, buf in a production model the weakness produced by cutting the slots would be bridged and re-inforced from behind to maintain the strength & mass balance of the disc.

Since the splined(or square.) shaft (S2,) holds the Starwheel (S.W.) firmly in mesh with the recesses in the Disc (D) at all times, the position of the Starwheel (S. W.) radially, can only be changed when the Prime Radius(P.R.) is brought into alignment with the shaft (S.2.) this can be achieved by visual observation, or by fitting a simple register stop. (not shown.) to the perimeter of the disc (D) to ensure that the correct position is obtained before the gear lever is moved.

To change gear ratios with THE RADIAL CHANGE MULTIGEARS ;-

1. The rotation of the disc is stopped at the point of alignment of the Prime Radius (P.R.) with the Shaft (S.2.).

2. The gear lever(G.L.) is lifted from its register slot (R1-R7.) and slid forwards or backwards until the desired gear ratio is reached.

3. The gear lever is then placed in that register slot and the gear is engaged and transmission of drive in the new gear is resumed in seconds.

ACHIEVING COMPATABILITY OF GEAR SURFACE CONTACT AT DIFFERENT GEAR RATIO SETTINGS :-

To transmit mechanical energy efficiently from one rotating gearwheel to another, there must be a closely matching and substantial area of contact between the hard surface of one gear moving in pressured contact with another in order to avoid the breakdown of the lubricant, excessive rates of wear and the subsequent dispersal of the mechanical energy in the form of heat.

(All Refs. are relating to 1/6.)

In this invention, compatability of the tooth contact between the Starwheel (SW) and the recesses in Disc (D) over a wide range of differing gear diameters is obtained by having the teeth on the Starwheel (SW) rounded on their front and rear edges to match the internal radii of the (R) recesses into which they have to mesh.

Since the Starwheel (SW) is rotating in a pre-located position on the shaft (S2) in a position tangental to the circle of recesses which has been selected, lateral allowance has to be made for the teeth to commence entry into the recesses prior to the full drive contact position being attained. This is achieved by radius-ing the mouth of each recess to match the radius between the teeth of the Starwheel (SW) (ref. Panel E section A. A') thus making the initial entry to each recess wide enough to be entered by the teeth as they come towards the full meshing position.

REFER TO DIAGRAM ON 2/6.

Due to the radial path of each recess (R.) on disc (D.) as it comes into the meshing position, it performs in effect, a lateral movement towards the tooth of the Starwheel (SW.) bringing it into close contact as it crosses the Prime Radius position (PR.) where maximum drive is transmitted, withdrawing as it passes out of that position by further rotation. At the same time, the tooth(T.) is being withdrawn by the rotation of the Starwheel (SW.).

The length of contact varies with the radius of each gear circle of recesses, being shorter near to the centre of the disc (D.) and longer as the radius increases.

In the diagram, the relative position of a recess (R..) is shown at different degrees of rotation as it comes into mesh with the tooth (T.) on Starwheel SW.). Three different radii tracks are shown:-R1, R2 &R3. Where (DC.) is the disc centre, (PR) is the Prime Radius line at C.

Position A, shows:- the relative position of tooth T 10° before P.R.

" B, " " " " " " " 5° " " ".

" C, " " " " " " " on the P.R.

" D, " " " " " " " 5° past P.R.

" E, " " " " " " " 10° " " ".

ADDITIONAL DEVELOPMENTS.

THE RADIAL CHANGE MULTIGEAR may be set out in a number of forms, although the underlying principle of SLIDING THE STARWHEEL PINION SW ALONG THE RADIUS TO CHANGE THE GEAR RATIO, (As is set out on pages 2,3,4, & 1/6.) remains the same.

Ex. 1. As shown in the drawing Fig. 1. (3/6.) with the Prime Radius positioned in the VOID SLOT, along which a single tooth of the Starwheel as set out in Page 1/6, can traverse radially when the gear ratio is being changed. The Setting out of the recesses on the disc D.for the VOID CENTRED PRIME RADIUS is shown in Fig. 1. (3/6.)

Ex. 2. The PRIME RADIUS of disc D, may also be SOLID CENTRED as is shown in Fig.2. (3/6.), in this case the of the teeth on the Starwheel SW. are contacting either side of the solid bar through which the PRIME RADIUS is centred.. This can be seen at section A.A'. set out on the diagram in (4/6.) Where PR. Represents the Prime Radius, D the disc and SW. the Starwheel-pinion. The slots are produced by removing the metal between the two sets of recesses parallel to the Prime Radius PR.

When a gear change is made, the teeth of the Starwheel SW., slide along the SOLID CENTRED PRIME RADIUS to the desired ratio position.

Ex. 3. The disc D. may have more than one PRIME RADIUS upon which gear ratio changes may be made, so that turning the disc D through a full revolution to change gear is not necessary. An example of the layout of the recesses for this is set out on(5/6.).

THE POLYRADIAL CHANGE MULTIGEAR.

By carefully selecting the diameter of the disc D. (Ref. 5/6. . .), the number of gear ratios required, the size of the recesses, the thickness of Starwheel SW. and the pitch of the teeth on SW, it is possible to calculate the radial positions of a number of concentric circles (To the centre of disc D.) each of which can be divided into a number of CHORDS equal in length to the point pitch of the Starwheel SW. which produce sets of multiples. For example:- If the numbers 16, 20, 24, 28, 32, 36 & 40, were found to be sufficiently radially spaced not to cause a weakening of the disc D when the recesses were cut into it, then it would be possible to fix either two or four positions for the PRIME RADII.

This is the layout of the recesses on the disc D shown in (5/6.). where the four PRIME RADII marked PR are running through the SOLID CENTRED bars between the slots which allow for the radial gear selections.

On this gear wheel only 90° rotation is required to set up the position for a radial gear change. Alternatively, had only two sets of slots been cut, the change could be made every half revolution. Other combinations based on other figures such as three and five could be set up if desired.

In the simple applications such as with the drilling machine, one prime radius would be sufficient, with a simple stop register to locate it, and the required gear up or down selected at a single movement of the gear lever.

THE RADIAL CHANGE MULTIGEAR IS APPLIED TO A GEAR DISC WHICH HAS ONLY ONE PRIME RADIUS, it may be based on a VOID or SOLID CENTRED P.R. The POLYRADIAL MULTIGEAR has more than one PRIME RADIUS SET OUT ON on the disc D. (Refer to 6/6 and 5/6.)

Both of these forms of gear can be used in conjunction with another gear of the same sort to set up a multiple combination drive.

Eg. The gear set up shown on 6/6. Fig. 1. shows a combination of a seven gear, void centred multigear linked by a shaft to a void centred two gear disc, which gives 14 different ratios in two ranges of seven.

Eg. 2. Shows a view of two, seven gear, solid centred, multigears. The larger one on the left has two PRIME RADIUS Change points, while the smaller one on the right has four prime radius change points, thus providing seven ranges of seven gears or 49 speeds. (Gear change levers omitted.)

The Polyradial Multigear has distinct advantages, it provides a wide number of gear ranges and with a crank wheel having two Prime radii set at right angles to the cranks, the rider would know by the position of the pedals whether he was in position to change gear, for when either pedal was at its lowest the Prime radius would be in position to change.

Changing the multigear at the wheel drive would only require a slight 'backpedal' to bring the nearest prime radius into line for the change to be made when it contacted the stop register.

On the model shown, the drive to the rear wheel of the bicycle is in the same direction as the motion of the crank wheel.

Notwithstanding the specific description contained in the foregoing, the invention relates generally to a drive transmission.

According to the invention there is provided a drive mechanism comprising a first member rotatable about an axis and having successive sets of abutments respectively at different distances from the axis;

and a second rotatable member having a set of abutments adapted for meshing with said successive sets of abutments;

characterised in that the first member is provided with at least one passageway extending transversely through the sets of abutments; and the said members are movable one relative to the other along such passageway to bring the abutments of the second rotatable member into mesh with different ones of the sets of abutments of the first member.

In one embodiment, the first member is a perforated disc and the second member is a movable cog.

The passageway is preferably radial and in the context of a perforated disc is a slot. There may be two or more parallel such slots and there may be multiple such passageways at different points spaced around the disc.

CLAIMS.

1, A multispeed gearing system, comprising a strong metal disc which is perforated with shaped recesses,,geometrically set out in concentric cirrcles, with each circle being positioned so that one recess in each circle is centred upon a chosen radius (or radii, as will be noted later) known as the PRIME RADIUS.

Each circle is drawn upon a radius calculated to contain a different number of recesses on its circumference, each one spaced from the next at a distance between centres, equal to the pitch distance of the teeth on a small pinion wheel which is situated in a position to mesh with the recesses when the disc or the pinion is rotated.

The pinion is robustly supported on a square (or splined) shaft, set along the Prime Radius and at the right distance from it to cause it to intermesh with the disc recesses on each circle when placed in the position to do so.

Movement of the pinion along a radial path from one circle of recesses to another, is facilitated by removing the metal from the Prime Radial and the adjacent parallel interstices on either side of the Prime Radius to provide clear radial paths or slots for the radial movement of the pinion, while at the same time maintaining the correct profile on the slot section for correct drive contact to be made when the assembly is rotating.

CLAIMS (cont.)

2. A Radial Change Multispeed Gear as is set out in claim 1., but instead of having its Prime Radius centred through a line of recesses, the Prime Radius is centred to run through the interstices, with the (near) radial lines of recesses at an equal distance on either side of it at a half tooth pitch distance. This results in the Prime Radius being centred in a solid radial bar when the two slots are cut to provide radial movement facility for the pinion at the point of gear change.

The princples of the Radial Change Multigear are still embodied in this ; only the layout arrangement of the circles on the disc is slightly different.

3. A multiple gearing system as claimed in claim 1.& 2. with a push-rod sliding mechanism for placing the pinion (or Starwheel) into mesh with any of the gear circles by sliding it along a radial path in one straight, continuous movement, whilst still maintaining the full meshing contact position with the disc.

4. A POLYMULTIPLE GEARING SYSTEM WITH A RADIAL CHANGE FACILITY as claimed in claims 1. 2. and 3. which can also be set out in various geometrical proportions to provide a gear disc with a number of PRIME RADIUS points at which a gear change may take place.

CLAIMS.

5. This invention claims :- A POLYRADIAL CHANGE MULTIGEAR SHAFT DRIVE SYSTEM to turn the driving wheel of a pedal bicycle using the combined gear systems set out in claims 1. 2. 3. and 4. Consisting of a pedal-crank driven perforated disc, driving a pinion mounted on a drive shaft at its forward end, passing on its rotary motion to another pinion at its rear end, which is engaged with another recessed gear disc which drives the rear wheel. The energy for the motion then, is transferred to the rear wheel entirely by the discs, pinions and the rotating shaft; completely eliminating the use of a chain.

6. A combined gear system for pedal cycles which provides a greater number of gear ratios to select from than any other cycle gearing systems currently on the market and with having fewer moving parts, the over-all transmission efficiency will be higher.

7. A quick change-over gearing system which can have many other applications where a light, positive drive and a wide selection of gear ratios is required, such as :-

A bench drilling machine. An electrically driven wheel chair for handicapped people. A wood turning lathe.

Amendments to the claims have been filed as follows :

8. A drive mechanism comprising a first member rotatable about an axis and having successive sets of abutments respectively at different distances from the axis;

and a second rotatable member having a set of abutments adapted for meshing with said successive sets of abutments;

characterised in that the first member is provided with at least one passageway extending transversely through the sets of abutments; and the said members are movable one relative to the other along such passageway to bring the abutments of the second rotatable member into mesh with different ones of the sets of abutments of the first member.

9. A drive mechanism according to claim 8 further characterised in that the first member is a perforated disc and the second member is a movable cog.

10. A drive mechanism according to claim 8 or 9 wherein the passageway is radial.

11. A drive mechanism according to claim 8, 9 or 10, wherein the passageway is a slot.

12. A drive mechanism according to claim 11, wherein two or more parallel such slots are provided.

13. A drive mechanism according to any of claims 8 to 13 wherein multiple such passageways ar provided at different points spaced around said first member.

14. A drive mechanism as substantially hereinbefore described with reference to and as illustrated in the accompanying drawings.

15. A multi-speed gearing system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number: GB 9200543.8

Relevant Technical fields

(i) UK Cl (Edition 1) F2D (DTC)

(ii) Int Cl (Edition 5) F16H 3/00

Search Examiner: J A L CALVERT

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI, CLAIMS

Date of Search: 27 JANUARY 1993

Documents considered relevant following a search in respect of claims 1-5

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	US 4813302 A (DAVIDOW) see Figure 3	1
X	US 4019405 A (WINTER) whole document	

SF2(p)

ab - doc99\fil000434

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

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